2008 Southern Hemisphere Biomass Burning Season as Seen by OMI and CALIPSO

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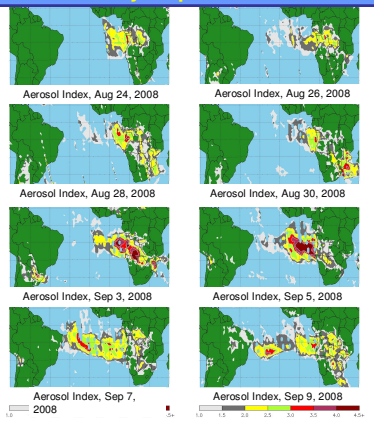
1. Abstract

Carbonaceous aerosols from biomass burning is the dominant pollution component in the atmosphere. Biomass burning in Africa and South America has a seasonal cycle driven by well established land-clearing agricultural practices. Fire activity in Africa starts early in the SH winter and goes on for about four months. The biomass burning season in South America is shorter with a duration of about three months.

The 2008 SH biomass burning season was characterized by heavy smoke production in Africa that moved west from Central Africa into South America during the August-September period. The extent of the African smoke plume was so widespread than on several days it blanketed the Southern Atlantic Ocean from the West coast of Central Africa to the Eastern shore of Brazil. The South American smoke plume, on the other hand, was very intermittent and did not have the spatial extent of previous years. Observations of Aerosol Index (AI) and Aerosol Absorption Optical Depth (AAOD) by the Ozone Monitoring Instrument (OMI) and vertical profiles of 532 nm Total Attenuated Backscatter from Cloud-Aerosol Lidar and Infrared Pathfinder Satellite (CALIPSO) are used to analyze the spatial and temporal variability of the SH smoke plume.

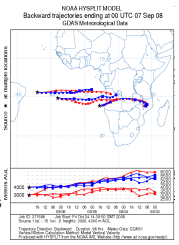
In this presentation we document the 2008 SH biomass burning season as seen by OMI and CALIPSO and examine the prevailing meteorological conditions driving the burning activity itself as well as the aerosol transport patterns.

2. Daily maps of OMI AI



OMI aerosol index (L3_aersl_omi, 1x1 deg) over South America (CA), South Atlantic Ocean (AO) and Central Africa (CA) during August 24, 26, 28, 30, September 3, 5, 7 and 9, 2008. The areas in Central Africa south of the equator indicate aerosol produced by biomass burning.

Large amounts of the aerosol are transported by the prevailing winds across the South Atlantic Ocean all the way to the East coast of South America, and even going over the continent as observed on September 7 and 9.

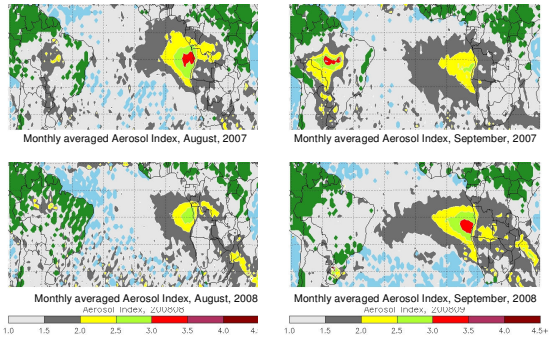


Four-day HYSPLIT back trajectories for three ending points for Sep 7 2008 are shown on the right. Model calculations indicate that the transport took place between 3 and 6 km. Initialization heights were taken from CALIPSO observations.

3. Monthly maps of fire season in 2007 and 2008

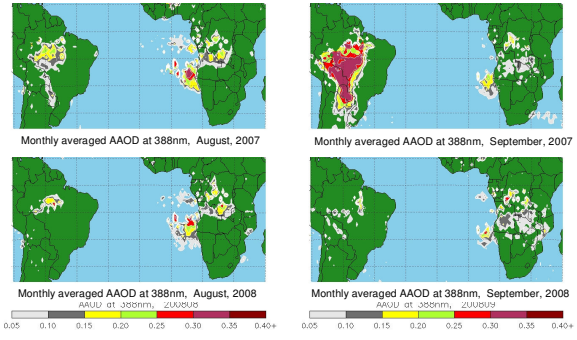
OMI Aerosol Index (L3_aersl_omi)

Heavy smoke amounts from biomass burning hung over South Africa and Atlantic Ocean.



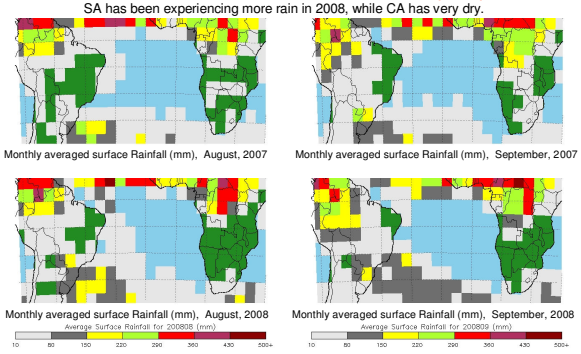
OMI Aerosol Absorption Optical Depth (OMI-Aura_L3-OMAERUVd)

The August and September monthly OMI AAOD in South America in 2008 is significantly lower than the observed monthly averages in 2007.

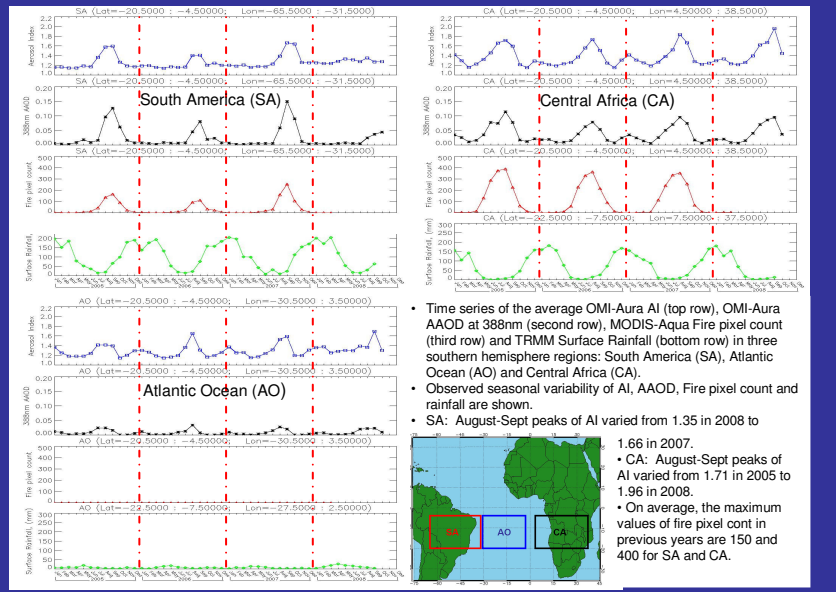


TRMM combined accumulated surface rainfall (3B31)

SA has been experiencing more rain in 2008, while CA has very dry.

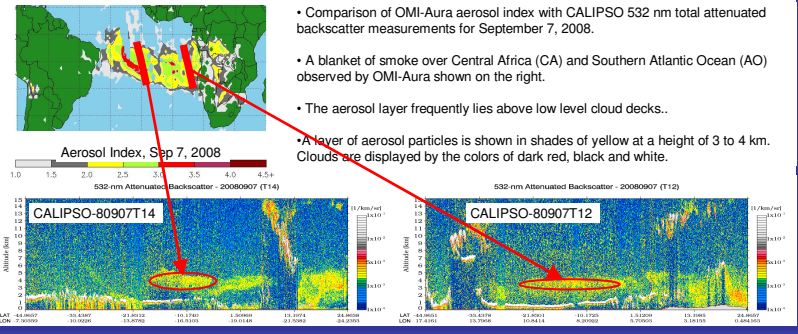


4. Four-year trends in the three southern hemisphere regions



- Time series of the average OMI-Aura AI (top row), OMI-Aura AAOD at 388nm (second row), MODIS-Aqua Fire pixel count (third row) and TRMM Surface Rainfall (bottom row) in three southern hemisphere regions: South America (SA), Atlantic Ocean (AO) and Central Africa (CA).
- Observed seasonal variability of AI, AAOD, Fire pixel count and rainfall are shown.
- SA: August-Sept peaks of AI varied from 1.35 in 2008 to 1.66 in 2007.
- CA: August-Sept peaks of AI varied from 1.71 in 2005 to 1.96 in 2008.
- On average, the maximum values of fire pixel cont in previous years are 150 and 400 for SA and CA.

5. Comparison of OMI AI with CALIPSO Total Attenuated Backscatter



- Comparison of OMI-Aura aerosol index with CALIPSO 532 nm total attenuated backscatter measurements for September 7, 2008.
- A blanket of smoke over Central Africa (CA) and Southern Atlantic Ocean (AO) observed by OMI-Aura shown on the right.
- The aerosol layer frequently lies above low level cloud decks..
- A layer of aerosol particles is shown in shades of yellow at a height of 3 to 4 km. Clouds are displayed by the colors of dark red, black and white.

6. Summary

- The OMI-Aura Aerosol Index (AI) and 388 nm Aerosol Absorption Optical Depth (AAOD) were combined with the observations of CALIPSO 532 nm attenuated backscatter, MODIS fire pixel count and TRMM surface rainfall for the seasonal biomass burning in Southern Hemisphere.
- The CALIPSO observations of aerosol backscatter vertical profiles confirm the most layer of biomass smoke at a altitude of 3-4 km.
- The 2008 biomass burning season is characterized by low fire activity in SA and high aerosol emission in CA. Daily maps of the OMI-Aura AI show a spatially continuous layer of smoke extending from the Western coast of Africa to the Eastern coast of Brazil, and even advancing over the continent.
- Time series analysis indicated that the transport patterns in 2008 are significantly different that in previous years for the regions of CA, AO and SA. The maximum of the annual cycle of biomass burning activity for four years occurred in August and September; and the minimum of rainfall occurred in May to August. The August-Sept peaks of AI in CA in 2008 is higher than in the previous years by a factor of 0.124, while the SA peaks in 2008 and 2007 differed by about 15%. The high AI values over the AO also illustrate a very efficient transport of smoke across the oceans.
- The 2008 biomass burning season in Southern Hemisphere departed significantly from observations in previous years.